8-25-06

OIPE IAP19 AUG 2 3 2006 PATENT & TRADEMARK OFFICE

TRANSMITTAL OF APPEAL BRIEF

Docket No. 56710(70801)

In re Application of: Nobuyuki Takamori et al.

Application No.	Filing Date	Examiner	Group Art Unit
10/002,952-Conf. #5464	November 15, 2001	M. J. Angebranndt	1756

Invention: OPTICAL DATA RECORDING MEDIUM

TO THE COMMISSIONER OF PATENTS:

Transmitted herewith is the Appeal Brief in this application, with respect to the Notice of Appeal filed: January 23, 2006.

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Dated: August 23, 2006

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Attorney Docket No. 56710 (70801)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Nobuyuki Takamori et al.

Application No.: 10/002,952

Confirmation No.: 5464

Filed: November 15, 2001

Art Unit: 1756

For: OPTICAL DATA RECORDING MEDIUM

Examiner: M. J. Angebranndt

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Alexandria, VA 22313-1450

BRIEF ON APPEAL

Sir:

This is an appeal from the final rejection of claims 1, 5, 6 and 10-14, as included in the Final Office Action mailed by the U.S. Patent and Trademark Office on August 23, 2005.

BRIEF ON APPEAL FEE

Authorization to charge Deposit Account No. 04-1105 for $500.00, covering the appeal brief fee, is provided herewith. However, if for any reason a fee is required, a fee paid is inadequate or credit is owed for any excess fee paid, the Commissioner is hereby authorized and requested to charge Deposit Account No. **04-1105**.

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REAL PARTY IN INTEREST

The real party in interest is Sharp Kabushiki Kaisha. The assignment of the inventors to this corporation was recorded on November 15, 2001, at Reel 012355, Frame 0500.

RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences known to Appellants, Appellants' legal representative, or the assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

STATUS OF CLAIMS

Claims 1-14 have been presented in this application. Claims 2-4 and 7-9 have been cancelled. Claims 1, 5, 6, and 10-14 stand finally rejected. Claims 1, 5, 6 and 10-14 are appealed. See the Claims Appendix attached hereto.

STATUS OF AMENDMENTS

An Amendment (after final rejection) was filed on November 23, 2005. This Amendment was not entered, according to an Advisory Action mailed by the U.S. Patent and Trademark Office on December 12, 2005.

A clean set of the claims on appeal (i.e., the claims as pending prior to the Amendment After Final) is set forth in the Claims Appendix hereto.

SUMMARY OF CLAIMED SUBJECT MATTER

Independent claims 1, 10, 12 and 14 are pending in the application.

The present invention provides optical data recording media which are resistant to deformation (e.g., warp) due to changes in humidity levels. Thus, the present invention provides optical data recording media which are resistant to warpage or deformation induced by changes in relative humidity (see, e.g., page 5, lines 10-13). More particularly, the present invention provides optical data recording media in which the expansion coefficient under humidity of the protective film and the transparent substrate are regulated to prevent a bending force that can induce a warp or bend in the medium. As discussed in the specification (e.g., at page 7, line 22 – page 8, line 8), warping of the medium due to changes in humidity is suppressed by reciting a relationship between the expansion coefficient under humidity of the protective film, and the expansion coefficient under humidity of the transparent substrate. By balancing the bending moments of the transparent substrate and the protective layer, warping due to changes in humidity is suppressed.

Independent claim 1 recites an optical data recording medium including a transparent substrate, a thin film layer formed on the transparent substrate and a protective film which is mainly comprised of a resin and formed on the thin film layer for protecting the thin film layer (see, e.g., page 5, lines 14-25). In claim 1, an expansion coefficient under humidity of the protective film is greater than that of the transparent substrate, and is smaller than 5.5×10^{-5} (1/%) and the thickness of the protective film is 5 μm to 20 μm (see, e.g., page 8, line 25 – page 9, line 1, and Figure 7).

Independent claim 10 recites an optical data recording medium comprising a transparent substrate, a thin film layer formed on the transparent substrate and a protective film which is mainly comprised of a resin and formed on the thin film layer for protecting the thin film layer. The thin film layer is a single layered or multilayered film including at least any one of a dielectric film, a recoding film and a reflective film, and an expansion coefficient under humidity {ratio of expansion (1/%) where a difference of relative humidity (vapor content/saturated vapor

amount at 25°C) is increased by 1%} of the protective film is greater than that of the transparent substrate and smaller than 5.5×10^{-5} (1/%), and a Young's modulus of the protective film is greater than 4.0×10^{9} (Pa) and smaller than 1.0×10^{10}(Pa), and the thickness of the protective film is 5 μm to 20 μm (see, e.g., page 8, line 15 – page 9, line 1, and Figure 7).

Independent claim 12 recites an optical data recording medium includes a transparent substrate, a thin film layer formed on the transparent substrate and a protective film which is mainly comprised of a resin and formed on the thin film layer for protecting the thin film layer. The expansion coefficient under humidity, Young's modulus and thickness of the protective film are suitably adjusted so that the bending moments of the transparent substrate and the protective film generated by change in humidity are balanced with a neutral plane being a plane perpendicular to the film thickness direction and the position of the neutral plane is arranged within the thin film layer (see, e.g., page 13, line 19 – page 14, line 5, and page 17, lines 1-9).

Independent claim 14 recites an optical data recording medium consisting essentially of a transparent substrate, a thin film layer formed on the transparent substrate and a protective film which is mainly comprised of a resin and formed on the thin film layer for protecting the thin film layer. According to claim 14, the expansion coefficient under humidity of the protective film is greater than that of the transparent substrate and smaller than 5.5×10^{-5} (1/%) and the thickness of the protective film is 5 μm to 20 μm (see, e.g., page 8, line 25 – page 9, line 1, and Figure 7).

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

The only ground of rejection to be reviewed on appeal is:

(1) Whether claims 1, 5, 6, and 10-14 are unpatentable under 35 USC §102(b) over JP 2000-311381 to Tajima et al. (hereinafter "Tajima").

ARGUMENT

1. Brief summary of argument

A single Section 102(b) rejection based on a single document (Tajima et al.) is outstanding in this case. The rejection cannot be sustained.

The cited document does not disclose or otherwise suggest (explicitly or inherently) Appellant's claimed invention. In particular, the document does not disclose optical recording media according to the pending claims, in which the expansion coefficient under humidity has a predetermined value.

The rejected claims do *not* stand or fall together since certain claims are considered separately patentable. Appellant submits that all of the claims under appeal are patentable including for reasons set forth below.

2. Examiner's position

The Examiner has acknowledged that the cited document (Tajima) does not describe all the features of Appellant's claimed invention. However, the Examiner has taken the position that the reference inherently discloses optical recording media having the properties of Appellant's claimed media.

For example, the Examiner states that "[w]hile the expansion coefficient as a function of humidity is not disclosed, the effects certainly are." See page 4 of the Final Office Action dated August 23, 2005. The Examiner further asserts that the embodiments recited in Table 5 of Tajima satisfy the limitations of the instantly claimed invention and that "the data in the tables establishes this."

3. Appellant's arguments

A. The cited document does not disclose all the features of the claimed invention, explicitly or inherently.

The Tajima Reference

The Tajima reference is directed to optical recording media in which the warpage caused by temperature changes is reduced (see, e.g., the Abstract).

At paragraphs [0035]-[0041], the Tajima reference discloses an example of an optical information recording medium made of three layers (a transparent substrate, a thin film layer, and a thin film protective coating). In this medium, the linear expansion coefficients and thicknesses of the transparent substrate and the thin film protective coat are adjusted to reduce the warp of the medium caused by temperature change.

In paragraph [0024], the Tajima reference describes that, because the linear expansion coefficients of the transparent substrate and the thin film protective coating are greater than the linear expansion coefficient of the thin film layer, and because the thickness of the transparent layer is greater than the thickness of the thin film layer, the medium is warped in a direction toward the thin film protective coating defined as the plus (+) direction as the temperature

changes.

Paragraphs [0049]-[0053] and Fig. 5 of the Tajima reference refer to Example 3 in which the medium further includes a substrate protective coating for reduction in an overshoot in the humidity change. In this medium, the moisture vapor transmissions of the substrate protective coating and the thin film protective coating are adjusted. Figure 5 of the Tajima reference shows that the medium of Example is warped in a direction toward the transparent substrate defined as a minus(-) direction after the passage of a predetermined time.

From the above, it can be seen that the medium of the Tajima reference is warped in the direction *towards the thin film protective coat* defined as the plus (+) direction as the *temperature* changes, while it is warped in the direction *towards the transparent substrate* defined as a minus (-) direction after the passage of a predetermined time. In other words, the direction of warpage due to temperature change is opposite the direction of warpage due to humidity change.

Tajima neither discloses nor suggests a substrate film or a protective film of an optical recording media which has an expansion coefficient under humidity of less than 5.5×10^{-5}(1/%), as recited in independent claims 1, 10 and 14. Moreover, while Tajima does mention variations in camber-angle when humidity is changed, Tajima does not teach or suggest preventing humidity induced warpage or deformation by controlling the magnitude and ratio of the expansion coefficient under humidity of the protective layer or the transparent substrate. The four-layer structure disclosed by Tajima (e.g., in Figure 1) is similar to a conventional medium as described for Comparative Example 1 of the present specification, which, as mentioned below, has an expansion coefficient under humidity of 6.25×10^{-5}(1/%).

B. The Tajima reference does not anticipate the pending claims.

(i) Claims 1, 5, 6 and 10

It is well-established that a claim is anticipated only if each and every element or feature of a claim is expressly or inherently described in a single prior art reference. See, e.g., MPEP 2131.

In the present case, the Examiner appears to agree that the Tajima reference does not expressly disclose all the elements of the presently-claimed invention. The Examiner nevertheless rejected the claims because "t[t]he examiner is holding a position of inherency." Final Office Action at page 4.

Inherency, however, may not be established by probabilities or possibilities." MPEP 2112(IV), citing *In re Robertson*, 169 F.3d 743, 745 (Fed. Cir. 1999) (citations omitted) (emphasis added).

The Examiner asserts that the embodiments recited in Table 5 of Tajima satisfy the limitations of the instantly claimed invention and that "the data in the tables establishes this." Appellants respectfully disagree. Table 5 of the Tajima reference recites film thickness, Young's Modulus, Linear Expansion Coefficient and Moisture Permeation Degree. The Tajima reference is *silent* concerning expansion coefficient of humidity.

From the discussion of the Tajima reference *supra*, it will be appreciated that the primary technical goal of the Tajima reference (reducing warpage caused by temperature change) is not readily applicable to the media of the invention, in which warpage due to changes in humidity is controlled by appropriate selection of the expansion coefficient under humidity of the protective film and of the transparent substrate, especially because the Tajima reference discloses media having opposite directions of warpage due to change in temperature and due to humidity change. One of ordinary skill in the art, upon reading the Tajima reference, would not recognize the reference as disclosing the optical recording media as presently claimed.

Tajima neither discloses nor suggests a substrate film or a protective film of an optical recording media which has an expansion coefficient under humidity of less than $5.5\times10^{-5}(1/\%)$ (as recited in independent claims 1, 10 and 14). Moreover, while Tajima does mention variations in camber-angle when humidity is changed, Tajima does not teach or suggest preventing humidity induced warpage or deformation by controlling the magnitude and ratio of the expansion coefficient under humidity of the protective layer and the transparent substrate. The four-layer structure disclosed by Tajima (e.g., in Figure 1 thereof) corresponds to a conventional medium as described for Comparative Example 1 of the present application, which, as mentioned below, has an expansion coefficient under humidity of $6.25\times10^{-5}(1/\%)$.

The Examiner also states (at page 3 of the Office Action) that the Comparative Example in the present specification meets the claim limitations (concerning humidity expansion coefficient). This statement is traversed. All the pending claims recite that the protective film of an optical recording media has an expansion coefficient under humidity of less than $5.5\times10^{-5}(1/\%)$. The Comparative Example to which the Examiner points describes a protective film having an expansion coefficient under humidity of $6.25\times10^{-5}(1/\%)$, which is not within the recited range of pending claims 1 and 10 (or the claims dependent therefrom).

The Examiner has also argued that "the humidity expansion coefficient is an inherent property of the material and that the protective layer of the prior art cited inherently meets this limitation." Final Office Action at page 3. The Examiner further states that

> "The examiner notes the materials disclosed in the instant application urethane, epoxy, polyester and polyether acrylates are disclosed as useful and meeting the material limitation of the claims in the instant specification..."

The Examiner appears to take the position that all urethane, epoxy, polyester and polyether acrylates which can be used in optical recording media inherently possess expansion coefficient under humidity values specified in the pending claims. Moreover, the Office Action appears to aver that because warping or tilting in the optical recording media is bad, that any prior art optical recording media which is designed to prevent warp or tilt caused by any stimulus automatically must also satisfy the claim limitations of the instant application.

Appellants do agree that the expansion coefficient under humidity is an inherent property of a material. However, a mere assertion that a property is inherent is insufficient to prove that a reference is anticipatory. Although Appellants agree that certain urethane, epoxy, polyester or polyether acrylate materials are useful in the present invention, the pending claims further require that each material used in the protective layer or the transparent substrate possess specified values for the expansion coefficient under humidity. Thus, the instant invention contemplates fabrication of the transparent substrate and protective layer from materials such as urethane, epoxy, polyester or polyether acrylate materials (or polyolefin or polycarbonate) which possess the requisite expansion coefficient under humidity (e.g., as specified in independent claims 1, 10 and 14 and the claims dependent therefrom). While the Examiner states that "urethane, epoxy, polyester and polyether acrylates are disclosed as useful and meeting the material limitation for the protective layer," Appellants contend that the instant specification does not suggest that all polyester, epoxy, urethane or polyether acrylates are useful in the present invention. Rather, the present specification teaches that those materials meeting *specified limitations* of expansion coefficient under humidity (and in certain claimed embodiments, Young's modulus) are useful in the claimed invention.

The claimed invention of claims 1, 5, 10-11 and 14 provides that the material of the protective film has an expansion coefficient under humidity value greater than that of the transparent substrate and that the expansion coefficient under humidity of the protective film is smaller than 5.5×10^{-5} (1/%). As disclosed by the present specification, optical data recording media which satisfy the above requirements are particularly resistant to deformation or warpage caused by changes in humidity.

For a reference to inherently disclose a feature not expressly disclosed, extrinsic evidence can be used to supply the missing feature if the extrinsic evidence "make[s] clear that the missing descriptive matter is *necessarily present* in the thing described in the reference and that it would be so recognized by persons of ordinary skill in the art. However, the Examiner has not provided any extrinsic evidence that the Tajima discloses *all the features* of the claimed invention.

The Tajima reference does not disclose materials having the characteristics of the claimed

optical recording medium. Moreover, no extrinsic evidence has been presented to show or establish that the protective layers or transparent substrates of the optical recording media of Tajima necessarily possess the expansion coefficient under humidity recited in claims 1, 10 and 14 (and the claims dependent thereupon).

Appellants respectfully submit that the materials disclosed in the Tajima reference do not necessarily possess the properties of the claimed invention. Materials described in similar general terms can and often do have quite different properties, including different expansion coefficient under humidity. It is clear that a reference disclosing a urethane acrylate, epoxy acrylate, or polyester or polyether acrylate would not necessarily provide a disclosure of a material having the claimed expansion coefficient under humidity.

(ii) Independent Claim 12

Appellants further note that the Examiner does not appear to have specifically addressed claim 12, in which an expansion coefficient under humidity, Young's modulus and thickness of the protective film are suitably adjusted so that the bending moments of the transparent substrate and the protective film generated by change in humidity are balanced with a neutral plane being a plane perpendicular to the film thickness direction and the position of the neutral plane is arranged within the thin film layer. The Examiner has not provided any evidence at all that the Tajima reference discloses (whether expressly or inherently) all the limitations of pending claim 12. Claim 12 is not even mentioned in the Final Office Action other than in the bare listing of claims rejected.

In the absence of any showing whatsoever that the Tajima reference discloses all the elements of pending claim 12, anticipation has not been established and the rejection cannot stand. Appellants respectfully contend that the Tajima reference does not teach or suggest the optical recording medium as claimed in pending claim 12.

(iii) Independent Claim 14

In addition to the arguments presented above in Section (i) with respect to claims 1 and 10 (which also apply *mutatis mutandis* to claim 14), pending claim 14 recites that as optical data recording medium *consists essentially of* a transparent substrate, a thin film layer formed on the transparent substrate and a protective film which is mainly comprised of a resin and formed on the thin film layer for protecting the thin film layer, wherein the thin film layer is a single layered or multilayered film including at least any one of a dielectric film, a recording film and a reflective film, and an expansion coefficient under humidity of the protective film is greater than that of the transparent substrate and smaller than 5.5×10^{-5} (1/%) and the thickness of the protective film is 5 μm to 20 μm. This optical data recording medium is not disclosed by Tajima, which discloses, e.g., a four-layered structure (see Figure 1) having an additional layer.

C. Comparative data effectively rebuts any *prima facie* case of anticipation that may be contended to exist

Moreover, while Appellant fully believes that a *prima facie* case of anticipation under 35 U.S.C. 102(b) has not been made by the Examiner, it is also believed that previously-presented test data fully rebuts any *prima facie* case that may be contended to exist.

In the "Amendment and Response" dated June 10, 2005 (a copy of the pertinent part of which is attached hereto), Appellants demonstrated that ultraviolet light curing resins do not all inherently have the properties of the presently-claimed optical recording media. Appellants measured the expansion coefficient under humidity of a medium having the composition shown in Example 3 of an alleged prior art reference (Tachibana, no longer applied to the pending claims). As a result of the measurement, it was found that the prior art medium has an expansion coefficient under humidity of 5.79×10^{-5} (1/%), which is outside the claimed value of less than 5.5×10^{-5} (1/%) recited in independent claims 1, 10 and 14 (and the claims dependent thereon).

See page 16 of the Amendment and Response dated June 10, 2005.

Appellants contend that this experiment provides additional support for Appellants' contention that the cited references do not necessarily disclose materials for optical data recording media having the properties of the claimed media. Appellants therefore contend that the inherency rejection cannot be maintained.

In summary, the Tajima reference does not teach or suggest optical recording media of the present claims which are resistant to deformation or warpage induced by changes in relative humidity. Moreover, the Tajima reference does not teach or suggest that the materials used in the fabrication of the optical recording media should be selected to have low expansion coefficients under humidity or that the expansion coefficient for the protective layer should be greater than that of the transparent substrate.

D. The remaining claims on appeal are separately patentable

The Tajima reference also provides no disclosure of other aspects of Appellant's claimed invention.

a) Claim 11

Claim 11 is separately patentable for the above-stated reasons and further because the Tajima reference fails to teach or suggest the optical recording medium of claim 1 wherein the expansion coefficient under humidity of the protective film is 7 or less times as great as that of the transparent substrate, the expansion coefficient under humidity being greater than 7×10^{-6} (1/%) and smaller than 5×10^{-5} (1/%), and a Young's modulus of the protective film is greater than 4.0×10^{9} (Pa) and smaller than 1.0×10^{10} (Pa). The Tajima reference does not teach or suggest this feature of claim 11.

b) Claim 13

Claim 13 is separately patentable for the above-stated reasons and further because the Tajima reference fails to teach or suggest the optical recording medium of claim 1 wherein the expansion coefficient under humidity of the protective film is greater than that of the transparent substrate and smaller than 1.6×10^{-5} (1/%). The Tajima reference does not teach or suggest this feature of claim 13.

SUMMARY

Appellants submit that all of the claims under final rejection are in condition for allowance and should be allowed, and that the Final Office Action should be vacated.

If for any reason a fee is required, a fee paid is inadequate or credit is owed for any excess fee paid, you are hereby authorized and requested to charge Deposit Account No. **04-1105**, under Reference No. 56710 (70801), Customer No. 21874.

Respectfully submitted,

Date: August 23, 2006

By: [signature]

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CLAIMS APPENDIX

1. An optical data recording medium comprising a transparent substrate, a thin film layer formed on the transparent substrate and a protective film which is mainly comprised of a resin and formed on the thin film layer for protecting the thin film layer, wherein the thin film layer is a single layered or multilayered film including at least any one of a dielectric film, a recording film and a reflective film, and an expansion coefficient under humidity [ratio of expansion (1/%) where a difference of relative humidity (vapor content/saturated vapor amount at 25°C) is increased by 1%] of the protective film is greater than that of the transparent substrate and smaller than 5.5×10^{-5} (1/%) and the thickness of the protective film is 5 μm to 20 μm.

2. – 4. (Cancelled).

5. An optical data recording medium according to claim 1, wherein the transparent substrate is made of a polycarbonate or a polyolefin and a thickness thereof is about 0.5 mm.

6. An optical data recording medium according to claim 1, wherein the protective film is made of an ultraviolet light curing resin.

7. – 9. (Cancelled).

10. An optical data recording medium comprising a transparent substrate, a thin film layer formed on the transparent substrate and a protective film which is mainly comprised of a resin and formed on the thin film layer for protecting the thin film layer, wherein the thin film layer is a single layered or multilayered film including at least any one of a dielectric film, a recoding film and a reflective film, and an expansion coefficient under humidity {ratio of expansion (1/%) where a difference of relative humidity (vapor content/saturated vapor amount at 25°C) is increased by 1%} of the protective film is greater than that of the transparent substrate

and smaller than 5.5×10^{-5} (1/%), and a Young's modulus of the protective film is greater than 4.0×10^{9} (Pa) and smaller than 1.0×10^{10}(Pa), and the thickness of the protective film is 5 μm to 20 μm.

11. An optical data recording medium according to claim 1, wherein the expansion coefficient under humidity of the protective film is 7 or less times as great as that of the transparent substrate, the expansion coefficient under humidity being greater than 7×10^{-6} (1/%) and smaller than 5×10^{-5} (1/%), and a Young's modulus of the protective film is greater than 4.0×10^{9} (Pa) and smaller than 1.0×10^{10} (Pa).

12. An optical data recording medium comprising a transparent substrate, a thin film layer formed on the transparent substrate and a protective film which is mainly comprised of a resin and formed on the thin film layer for protecting the thin film layer,

wherein the thin film layer is a single layered or multilayered film including at least any one of a dielectric film, a recording film and a reflective film, and

wherein an expansion coefficient under humidity, Young's modulus and thickness of the protective film are suitably adjusted so that the bending moments of the transparent substrate and the protective film generated by change in humidity are balanced with a neutral plane being a plane perpendicular to the film thickness direction and the position of the neutral plane is arranged within the thin film layer.

13. An optical data recording medium according to claim 1, wherein the expansion coefficient under humidity of the protective film is greater than that of the transparent substrate and smaller than 1.6×10^{-5} (1/%).

14. An optical data recording medium consisting essentially of a transparent substrate, a thin film layer formed on the transparent substrate and a protective film which is mainly comprised of a resin and formed on the thin film layer for protecting the thin film layer, wherein

the thin film layer is a single layered or multilayered film including at least any one of a dielectric film, a recording film and a reflective film, and an expansion coefficient under humidity [ratio of expansion (1/%) where a difference of relative humidity (vapor content/saturated vapor amount at 25°C) is increased by 1%] of the protective film is greater than that of the transparent substrate and smaller than 5.5×10^{-5} (1/%) and the thickness of the protective film is 5 μm to 20 μm.

EVIDENCE APPENDIX

Tab A Copy of JP 2000-311381 to Tajima et al. ("Tajima"), as relied on by the Examiner in the Final Office Action of 08/23/2005.

Tab B Portion of the "Amendment and Response" filed by Appellants, dated June 10, 2005.

RELATED PROCEEDINGS APPENDIX

None.

PATENT ABSTRACTS OF JAPAN

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(43)Date of publication of application : 07.11.2000

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(21)Application number : 2000-045449
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(71)Applicant : SHARP CORP
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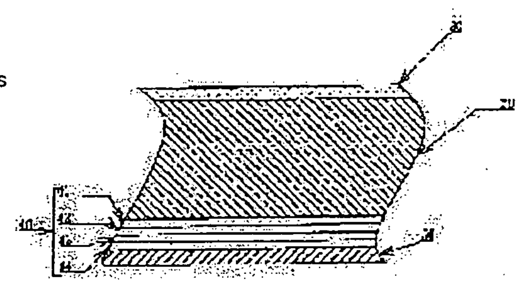
(30)Priority
Priority number : 11046189 Priority date : 24.02.1999 Priority country : JP

(54) OPTICAL INFORMATION RECORDING MEDIUM

(57)Abstract:
PROBLEM TO BE SOLVED: To make the deformation quantity at a temperature change smaller and to enhance the reliability of recording and reproducing by constituting an optical information recording medium in such a manner that the neutral surface at the deformation by a temperature change during recording and reproducing exists near thin-film layers, such as magnetic films.
SOLUTION: The optical information recording medium has the single or multilayered thin-film layers 40 consisting of the thin films including first and second dielectric films 41 and 43, the recording film 42, a reflection film 44, etc., on a transparent substrate 20 and is formed with a thin-film protective film 50 essentially consisting of a resin on the thin-film layers 40. A substrate protective film 30 essentially consisting of a resin for protecting the transparent substrate 20 is formed on the opposite surface of the transparent substrate 20. The coefficient linear expansion, Young's modulus and film thickness of the thin-film protective film 50 formed on the thin-film layers 40 are regulated, by which the bending moment reverse from the bending moment by the transparent substrate 20 is imparted to the thin-film layers 40. The plane which is included in the thin-film layers 40 and is parallel to the film plane is formed as the neutral plane of the deformation. As a result, the deformation due to the temperature change is suppressed.



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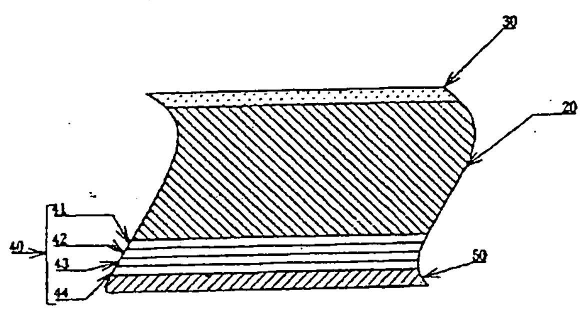
(54)【発明の名称】　光情報記録媒体

(57)【要約】
【課題】　温湿度変化に伴う変形（反り）を防止でき、且つ、その製造が容易な光情報記録媒体を提供する。
【解決手段】　光情報記録媒体１０は、透明基板２０と、透明基板２０上に形成され記録膜４２を含む薄膜層４０と、薄膜層上４０に形成された薄膜保護膜５０と、透明基板２０上に形成された基板保護膜３０を有している。この光情報記録媒体１０の温度変化に起因する変形の中立面は薄膜層４０内にある。



【特許請求の範囲】
【請求項１】　透明基板と、該透明基板上に形成され記録膜または反射膜のいずれか一方を少なくとも含む薄膜層と、該薄膜層上に形成された樹脂を主成分とする薄膜保護膜と、を少なくとも有する光情報記録媒体において、
記録再生時の温度変化による膜厚方向の変形の中立面が前記薄膜層近傍にあることを特徴とする光情報記録媒体。
【請求項２】　透明基板と、該透明基板上に形成され記録膜または反射膜のいずれか一方を少なくとも含む薄膜層と、該薄膜層上に形成された樹脂を主成分とする薄膜保護膜と、を少なくとも有する光情報記録媒体において、
前記薄膜層近傍において、膜厚方向におけるその両側から受ける曲げモーメントが、略等しいことを特徴とする光情報記録媒体。
【請求項３】　透明基板と、該透明基板上に形成され記録膜または反射膜のいずれか一方を少なくとも含む薄膜層と、該薄膜層上に形成された樹脂を主成分とする薄膜保護膜と、を少なくとも有する光情報記録媒体において、
前記薄膜保護膜は、そのヤング率及び線膨張係数の少なくとも一方が前記透明基板よりも大きいことを特徴とする光情報記録媒体。
【請求項４】　請求項１乃至請求項３のいずれかに記載の光情報記録媒体において、
前記薄膜保護膜の膜厚が、２０μm以下であることを特徴とする光情報記録媒体。
【請求項５】　透明基板と、該透明基板上に形成され記録膜または反射膜のいずれか一方を少なくとも含む薄膜層と、該薄膜層上に形成された樹脂を主成分とする薄膜保護膜と、前記透明基板の光入射側に形成された樹脂を主成分とする基板保護膜と、を少なくとも有する光情報記録媒体において、
前記薄膜保護膜の透湿度より前記基板保護膜の透湿度が小さいことを特徴とする光情報記録媒体。
【請求項６】　請求項５に記載の光情報記録媒体において、
記録再生時の温度変化による膜厚方向の変形の中立面が前記薄膜層近傍にあり、且つ、前記薄膜保護膜の膜厚が、前記基板保護膜の膜厚よりも厚いことを特徴とする光情報記録媒体。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】この発明は、情報を記録又は再生する光情報記録媒体に関し、特に、環境変化や経時変化による反りを抑制できる光情報記録媒体に関する。
【０００２】
【従来の技術】図１は、光情報記録媒体の構成を示す断面模式図である。図６は、その光情報記録媒体の平面図（ａ）及び側面図（ｂ）である。

【０００３】この光情報記録媒体は、図１，６に示すように、ポリカーボネート等からなる円板状の基板２０上に、スパッタ等により誘電体膜４１，４３（窒化シリコン等）、記録膜４２（ＴｂＦｅＣｏ等）、反射膜４４（Ａｌ等）等の薄膜からなる単層、または多層からなる薄膜層４０が形成されている。また、この薄膜層４０上に樹脂膜等による薄膜保護膜５０が、基板の光入射面上には樹脂等からなる基板保護膜３０が形成されている。これらのそれぞれの層及び膜の膜厚は、基板２０が約１．２〔ｍｍ〕、スパッタ等で形成される単層あるいは多層薄膜層４０の厚さは１０～３００〔ｎｍ〕、薄膜保護膜５０の厚さが１～３０〔μｍ〕、基板保護膜３０の厚さが１～３０〔μｍ〕であり、全厚のほとんどがポリカーボネイト基板２０によって占められている。このため光情報記録媒体の剛性は、そのほとんどが、ポリカーボネート基板２０に依存しており、ポリカーボネート基板２０が十分に厚いため、環境変化（温湿度変化）による変形は非常に小さかった。このため、通常は、各層に発生する応力や曲げモーメントのバランスはほとんどの場合考慮されていなかった。
【０００４】しかしながら、光情報記録媒体においては、更なる高密度記録再生が求められており、収差の発生を抑制するために基板が薄型化する傾向（例１．２〔ｍｍ〕厚→０．６〔ｍｍ〕厚）にある。この場合、当然、光情報記録媒体の剛性は低下し、環境変化（温湿度変化）によって光情報記録媒体を形成している各層に発生する応力に起因する変形が大きくなり、情報の記録再生が困難になるという問題が生じる。したがって、基板が薄くなり剛性が低下した場合においても、対環境性能の高い光情報記録媒体が求められている。
【０００５】光情報記録媒体の変形を抑制する手法として、特開平４－１９５７４５号公報には基板の裏面（薄膜層の形成されていない側の面）に反り防止用の誘電体膜を設ける手法が提案されている。
【０００６】図７はこの光情報記録媒体の構成を示す断面図である。なお、図７において図１と同一部分については同一符号を付している。図７に示すように、ここでは、ポリカーボネート基板２０の光入射側に誘電体層６０を設けて、透明基板２０の両側に位置する記録膜４２，と誘電体層６０との膨張率を同等とすることで、光情報記録媒体を透明基板２０に対して対称構造として、これにより光情報記録媒体の反りを防止できるようにしている。
【０００７】また、特開平１０－６４１１９号公報には、薄膜保護膜を厚く塗布することにより、光ディスクの温度上昇による反りを少なくすることが記載されている。
【０００８】また、光情報記録媒体が湿度変化によって

反ることを問題として、図８に示すような、薄膜保護膜５０，薄膜層４０，基板２０，基板保護膜３０を有する光情報記録媒体において、基板２０と基板保護膜３０との間にSiO_2やＡｌＮからなる透湿防止膜７０を設けたものが特開平４－３６４２４８号公報で提案されている。なお、図８において図１と同一部分については同一符号を付している。

【０００９】

【発明が解決しようとする課題】しかしながら、特開平４－１９５７４５号公報に記載の手法（図７参照）では、基板の光入射側にスパッタ等により誘電体層を設ける必要が有るため、生産において、基板に対して一方側の面に薄膜層を形成した後、その基板を引っ繰り返して反対側の面に誘電体層を形成する必要があり、工程が複雑化するとともに生産設備の高価格化を齎し、コストアップに繋がるという問題がある。

【００１０】また、特開平１０－６４１１９号公報に記載の手法では、薄膜保護膜の膜厚が厚くなりすぎ、製造上難があるという問題がある。また、例えば、光情報記録媒体が光磁気記録媒体であった場合、記録時に印加する磁界を高速で反転させるには磁界発生手段と薄膜層とを近接することが望ましく、薄膜保護膜の膜厚が厚くなることは磁気特性の劣化を齎し、問題である。

【００１１】さらに、特開平４－３６４２４８号公報に記載の手法（図８参照）でも、基板の光入射側にスパッタ等によりSiO_2やＡｌＮを設ける必要が有るため、生産において、基板に対して一方側の面に薄膜層を形成した後、その基板を引っ繰り返して反対側の面に誘電体層を形成する必要があり、工程が複雑化するとともに生産設備の高価格化を齎し、コストアップに繋がるという問題がある。

【００１２】本発明は、上記課題を解決するためになされたものであって、温湿度変化に伴う変形（反り）を防止でき、且つ、その製造が容易な光情報記録媒体を提供することを目的とする。

【００１３】

【課題を解決するための手段】請求項１に記載の光情報記録媒体は、透明基板と、該透明基板上に形成され記録膜または反射膜のいずれか一方を少なくとも含む薄膜層と、該薄膜層上に形成された樹脂を主成分とする薄膜保護膜と、を少なくとも有する光情報記録媒体において、記録再生時の温度変化による膜厚方向の変形の中立面が前記薄膜層近傍にあることを特徴とする。

【００１４】請求項２に記載の光情報記録媒体は、透明基板と、該透明基板上に形成され記録膜または反射膜のいずれか一方を少なくとも含む薄膜層と、該薄膜層上に形成された樹脂を主成分とする薄膜保護膜と、を少なくとも有する光情報記録媒体において、前記薄膜層近傍において、膜厚方向におけるその両側から受ける曲げモーメントが、略等しいことを特徴とする。

【００１５】請求項３に記載の光情報記録媒体は、透明基板と、該透明基板上に形成され記録膜または反射膜のいずれか一方を少なくとも含む薄膜層と、該薄膜層上に形成された樹脂を主成分とする薄膜保護膜と、を少なくとも有する光情報記録媒体において、前記薄膜保護膜は、そのヤング率及び線膨張係数の少なくとも一方が前記透明基板よりも大きいことを特徴とする。

【００１６】請求項４に記載の光情報記録媒体は、請求項１乃至請求項３のいずれかに記載の光情報記録媒体において、前記薄膜保護膜の膜厚が、２０μｍ以下であることを特徴とする。

【００１７】請求項５に記載の光情報記録媒体は、透明基板と、該透明基板上に形成され記録膜または反射膜のいずれか一方を少なくとも含む薄膜層と、該薄膜層上に形成された樹脂を主成分とする薄膜保護膜と、前記透明基板の光入射側に形成された樹脂を主成分とする基板保護膜と、を少なくとも有する光情報記録媒体において、前記薄膜保護膜の透湿度より前記基板保護膜の透湿度が小さいことを特徴とする。

【００１８】請求項６に記載の光情報記録媒体は、請求項５に記載の光情報記録媒体において、記録再生時の温度変化による膜厚方向の変形の中立面が前記薄膜層近傍にあり、且つ、前記薄膜保護膜の膜厚が、前記基板保護膜の膜厚よりも厚いことを特徴とする。

【００１９】なお、請求項１において、変形の中立面とは、後述する式（１）～（５）において、反り角θが略０となるときに、ｙの値により表される面を示している。

【００２０】

【発明の実施の形態】（実施の形態１）以下、本実施の形態の光情報記録媒体について説明するが、まず、本発明の原理を説明する。

【００２１】①原理

従来の技術の項で説明したように、特開平４－１９５７４５号公報（図７参照）に記載の光情報記録媒体では、透明基板２０に対して対称になるよう層を構成することで、光情報記録媒体の反りを抑制していた。

【００２２】これに対して、本発明者は、例えば、図１の断面模式図に示すような薄膜保護膜５０，薄膜層４０，透明基板２０，基板保護膜３０を有する光情報記録媒体において、（ａ）薄膜層４０を温度変化による変形の中心とすること，すなわち、薄膜層に対して対称に構成することで反りが抑制できる点、及び、（ｂ）反りの抑制に併せて薄膜保護膜５０の膜厚を薄くできる点を見出した。以下、さらに詳しく説明する。

【００２３】図１に示すように、一般に、光情報記録媒体は、ポリカーボネート等の透明基板２０上にスパッタ等により誘電体膜４１，４３（窒化シリコン等）、記録膜４２（ＴｂＦｅＣｏ等）、反射膜４４（Ａｌ等）等の薄膜からなる単層又は多層の薄膜層４０を有し，その薄

膜層４０上に樹脂を主成分とする薄膜保護膜５０が形成されているとともに、その透明基板２０の反対の面上に透明基板２０を保護するために樹脂を主成分とする基板保護膜３０が形成されている。

【００２４】このように光情報記録媒体は通常多層で構成されており、このため、各層の物性値である線膨張係数の相違等に起因して、温度変化時に各層に発生する応力が異なる結果となる。具体的には、一般に、ポリカーボネートからなる透明基板２０、及び、基板保護膜３０，薄膜保護膜５０の線膨張係数は薄膜層４０のそれに比較して大きく、薄膜層４０の基板の半径方向への膨張はその他の各層に比較して非常に小さくなる。また、透明基板２０の厚さは基板保護膜３０及び薄膜保護膜５０の厚さに比較して非常に大きく、薄膜層４０の各薄膜のヤング率が他の層に比較して非常に大きくなる。このため、温度変化が生じると、薄膜層４０の膨張が小さいの比して、透明基板２０の膨張が大きくなり、結果的に、光情報記録媒体１０は半径方向に垂直で且つ膜厚方向において薄膜保護膜５０側に向かう反りが生じ易くなる。図２はその反りを説明する模式図であり、（ａ）は平面図，（ｂ）は側面図である。

【００２５】本実施の形態ではこの反りを防止するために、薄膜層４０上に形成される薄膜保護膜５０の線膨張係数、ヤング率、及び膜厚を調整することで、薄膜層４＊０に対して、透明基板２０による曲げモーメントと逆向きの曲げモーメント与え、そして、薄膜層４０内に含まれ、膜面と平行な面を変形の中立面とすることで、温度変化による変形（図２に示すような反り）を抑制する。

【００２６】上記のような薄膜保護膜５０の線膨張係数、ヤング率、及び膜厚の設定は、次のような近似計算によって行える。

【００２７】光情報記録媒体１０には、温度変化時に半径方向に働く応力（軸力）と円周方向に働く応力と膜厚方向に働く応力が発生するが、光情報記録媒体１０は、円板状であるため、円周方向に働く応力は円周内で均一になり、膜厚方向の力も各層内では一様に働くため、変形には寄与しないと仮定できるため、光情報記録媒体１０の変形すなわち反り（図２参照）は、その断面部に相当する多層はりにおける反りに置換できる。図３はその多層はりを示す図である。なお、図３ではｎ層はりを示しているが、このｎは光情報記録媒体の層数であり、図１の光情報記録媒体の場合にはｎ＝７である。

【００２８】この多層はりにおける温度変化時の反り角度θは各層の軸力 P_i（ｉ＝１，２，…，ｎ）と曲げモーメント M_i の釣り合いから導かれる式（１）～（５）によって表わすことができる。

【００２９】

【数１】

$$M_i=\frac{E_iI_i}{R_i}. \; . \; . \; . \quad (1)$$

$$\alpha_iT+\frac{P_i}{bt_iE_i}-\frac{t_i}{2R_i}=\alpha_{i+1}T+\frac{P_{i+1}}{bt_{i+1}E_{i+1}}+\frac{t_{i+1}}{2R_{i+1}}. \; . \; . \; . \quad (2)$$

$$\sum_{i=1}^{n}P_i=0. \; . \; . \; . \quad (3)$$

$$\sum_{i=1}^{n}M_i+P_1\left(y-\frac{t_1}{2}\right)+P_2\left(y-t_1-\frac{t_2}{2}\right)+\cdots+P_n\left(y-t_1-t_2-\cdots-\frac{t_n}{2}\right)=0. \; . \; . \; . \quad (4)$$

$$\theta=\tan^{-1}\left(\frac{L-2}{R}\right). \; . \; . \; . \quad (5)$$

【００３０】なお、式（１）～（５）における各記号は、

α_i：ｉ層の線膨張係数　E_i：ｉ層のヤング率

t_i：ｉ層の厚さ　P_i：ｉ層における軸力

M_i：ｉ層における曲げモーメント　R_i：曲率半径

I_i：ｉ層の断面２次モーメント　ｂ：はりの幅（単位長とする）

Ｔ：変化温度　Ｌ：はりの長さ

ｙ：ｎ層はりの中立面位置

θ：最大変位部における長さ４ｍｍでの反り角度を示している。また、各層の厚さは曲率半径に比較してはるかに小さいため、各層（ｉ＝１，２，…，ｎ）における曲率半径は同一（$R_1=R_2=R_3=\cdots=R$）とする。また、変化温度Ｔは光情報記録媒体の使用温度環境（一般に－１５℃～８０℃）内における変化温度である。

【００３１】そして、この式（１）～（５）においてｙを薄膜層４０内に設定したときにθが小さくなるように、すなわち曲率半径Ｒが大きくなるように各層（特に薄膜保護膜５０（薄膜層４０については光情報記録媒体の特性により予め決められているとが多い））の厚さ，線膨張係数α，ヤング率Ｅを決定すれば、温度変化に伴う図２の反りを抑制できる光情報記録媒体を得ることができる。

【００３２】ところで、光情報記録媒体において薄膜保護膜５０の膜厚が厚くなると、それをスピンコートで形成することが難しくなる。また、光情報記録媒体が光磁気記録媒体の場合には薄膜保護膜５０の膜厚が厚くなると、磁気ヘッドと薄膜層４０との距離が離れることにな

り、磁気特性上好ましくない。これらのことから薄膜保護膜５０の膜厚は３０μm以下、更に良くは２０μm以下に設定することが望ましい。したがって、薄膜保護膜５０としては、上記膜厚条件（３０μm以下（望ましくは２０μm以下））を満たすとともに、上記式（１）～（５）においてθを小さくできる線膨張係数α，ヤング率Eの材料を選定することが必要である。式（１）～（５）によれば、線膨張係数α，ヤング率Eの少なくとも一方が大きければ、膜厚が小さくてもθを小さくすることが可能である。

【００３３】以上説明したように、本実施の形態の光情報記録媒体では薄膜層４０内に温度変化時における変形の中立面がくるように各層（特に薄膜保護膜５０）を設定するため、反りの発生を抑制できる。また、光情報記録媒体を構成している各層の中で変形速度の最も遅い薄膜層４０の変形がごく小さくなり、実際の温度変化時に問題となる変位のオーバーシュートも小さなものになる。さらに、透明基板２０の光入射側には樹脂を主成分とする基板保護膜３０のみを形成すればよいため、スピンコート等により簡単に製造でき、製造工程を簡略化できる。

【００３４】なお、上記説明では、光情報記録媒体を構成する全ての層の材料特性を用いて、温度変化による変形の中立面が薄膜層４０の内部に存在するように、各層（特に薄膜保護膜５０）の設定を行うことについて述べたが、一般に、光情報記録媒体における薄膜層４０を構成する各層は非常に薄いものであるため、薄膜層４０を１つの層と見なして、薄膜層４０に対してその両側（一方側が透明基板２０及び基板保護膜３０、他方側が薄膜保護膜５０）が温度変化により与える曲げモーメントが＊略打ち消し合うように、各層（特に薄膜保護膜５０）を設定しても良い。この場合でも、薄膜層４０の温度変化による反りを略無くすことができる。このとき、薄膜保護膜５０の膜厚を小さくする（３０μm以下（望ましくは２０μm以下））には、透明基板２０の厚さが大きいことを鑑みると、薄膜保護膜５０の線膨張係数α，ヤング率Eの少なくとも一方は、透明基板２０よりも大きいものである必要がある。

【００３５】②実施例

次に、上記原理に基づき形成した光情報記録媒体の実施例について説明する。なお、本実施例は、薄膜層４０が窒化アルミニウム１層のみからなると仮定している。これは、薄膜層４０の変形は一般に窒化アルミニウム等の誘電体層が主にその原因となる場合が多いからである。また、本実施例では基板保護膜３０が無い例を示している。基板保護膜３０が存在する場合にはそれをも考慮して各層（特に薄膜保護膜５０）の設定を行う必要がある。

【００３６】実施例１として、ポリカーボネイト基板（透明基板２０）上に、窒化アルミニウム薄膜層（薄膜層４０）と式（１）～（５）を用いて設計された条件の紫外線（UV）硬化樹脂１（薄膜保護膜５０）が形成された媒体を形成した。また、比較例１として、ポリカーボネイト基板上に、窒化アルミニウム薄膜層と従来の紫外線（UV）硬化樹脂２（薄膜保護膜）が形成された光情報記録媒体を形成した。表１，２にそれぞれ実施例１，比較例１の構成を示す。

【００３７】

【表１】

実　施　例　１

	材質	膜厚	ヤング率(Pa)	線膨張係数(1/℃)
透明基板	ポリカーボネイト	0.6mm	2.41E+09	6.00E-05
薄膜層	窒化アルミニウム	79nm	3.43E+11	5.60E-06
薄膜保護層	UV硬化樹脂1	16μm	1.80E+09	7.10E-05

【００３８】

※　※【表２】

比　較　例　１

	材質	膜厚	ヤング率(Pa)	線膨張係数(1/℃)
透明基板	ポリカーボネイト	0.6mm	2.41E+09	6.00E-05
薄膜層	窒化アルミニウム	79nm	3.43E+11	5.60E-06
薄膜保護層	UV硬化樹脂2	15μm	1.80E+09	5.62E-05

【００３９】表１，２から分かるように、両者の違いは、主にUV硬化樹脂（薄膜保護膜５０）の線膨張係数であり、実施例１の方が線膨張係数が大きいものを使用している。なお、透明基板２０としては、両者とも内径φ１５ｍｍ，外径１２０ｍｍのものを使用している。

【００４０】実施例１と比較例１の媒体に対して２５℃→５５℃に上昇する温度変化（上記のT＝３０℃）を与えて、そのときの外周部（ｒ＝５６ｍｍ）での反り角θの変化量の経時変化を測定した。なお、反り角そのものでなく反り角の変化量を測定した理由は、常温状態において、媒体は独自の反り角を持っているため、温度変化による変形を示すには不適格であるためである。

【００４１】図４はその結果を示す図である。実施例１の媒体の反り角の変化量は、最大値及び定常状態値のい

ずれも比較例１の媒体よりも小さく、変形を抑制していることが分かる。また、この図から、実施例１によれば、２０μm以下の膜厚であっても、温度が変化により一時的にも大きな反りが生じることがないことが分かる。さらに、図４には、上記式（１）～（５）を用いて予想した反り角θの変化量を併記しているが、上記式（１）～（５）による近似が実測値に非常に近く、その近似は実際に適合していることが分かる。

【００４２】次に、ヤング率の大きなＵＶ硬化樹脂３を使用した媒体（実施例２）について説明する。この実施例２の媒体は実施例１の媒体とＵＶ硬化樹脂の特性が異なっているものである。表３に実施例２の構成を示す。

【００４３】

【表３】

実　施　例　２

	材質	膜厚	ヤング率(Pa)	線膨張係数(1/℃)
透明基板	ポリカーボネイト	0.6mm	2.41E+09	6.00E-05
薄膜層	窒化アルミニウム	79nm	3.43E+11	5.60E-06
薄膜保護層	UV硬化樹脂3	16μm	3.60E+09	5.68E-05

【００４４】この実施例２の媒体について、上記式（１）～（５）を用いて反り角θの変化量を予想すると、その値は５．１８〔ｍｒａｄ〕であり、上述の比較例１に比して大幅に温度変化に起因する反りが減少していることが分かる。

【００４５】以上のように、本実施の形態の光情報記録媒体によれば、温度変化により一時的にも大きな反りが生じることを抑制できるため、記録再生時の温度上昇によっても再生不良等の問題が生じることを抑えることができる。また、薄膜保護膜５０の膜厚を薄くすることができる。

【００４６】（実施の形態２）本実施の形態では、湿度変化による変形を防止できる光情報記録媒体について説明する。

【００４７】①原理

上述した図１に記載の光情報記録媒体１０は、透明基板２０としてポリカーボネート等からなる基板を用いているため、周辺が高湿となったとき、透明基板２０が吸湿により膨張する。そして、これにより光情報記録媒体１０に変形が生じる。特に、基板保護膜３０の透湿度が薄膜保護膜５０の透湿度に比較して大きい場合は、基板２０の変形速度が薄膜保護膜５０の変形速度より大きくなるため、実際の湿度変化時に大きな変位のオーバーシュートが起き実用上において大きな問題となっていた。

【００４８】本実施の形態では、基板保護膜３０の透湿度を薄膜保護膜５０の透湿度に比較して小さくして、このオーバーシュートを抑制しすることにより、実用時における問題を解決する。

【００４９】②実施例

実施例３として上述の実施例１に記載の媒体にＵＶ硬化樹脂４からなる基板保護膜３０を付加した媒体を形成した。また、比較のため、比較例２として、上述の実施例１に記載の媒体にＵＶ硬化樹脂５からなる基板保護膜３０を付加した媒体を形成した。この実施例３，比較例２における各ＵＶ硬化樹脂の透湿度について表４に示す。

【００５０】

【表４】

	基板保護膜		薄膜保護膜	
	膜種	透湿度(g/m²·day)	膜種	透湿度(g/m²·day)
実施例3	UV硬化樹脂4	2.20E+02	UV硬化樹脂1	4.60E+02
比較例2	UV硬化樹脂5	9.70E+02	UV硬化樹脂1	4.60E+02

【００５１】この実施例３，比較例２の媒体に対して、湿度変化（周囲湿度を５０％→９０％に変化）を与えて、各媒体の外周部（ｒ＝５６ｍｍ）における反り角θの変化量の経時変化を測定した。

【００５２】図５はその結果を示す図である。実施例３の反り角の変化量の最大値（オーバーシュート時に発生）は比較例２のそれに比較して非常に小さなものとなり、湿度変化による変形が抑制されていることがわかる。

【００５３】このように本実施の形態の光情報記録媒体によれば、湿度が変化しても一時的にも大きな反りが生じることがなく、記録再生時に再生不良等の問題が生じることを抑制できる。

【００５４】なお、本実施の形態の光情報記録媒体においても、実施の形態１に記載のように薄膜層４０内に温度変化による変形の中立面を有するように、また、薄膜層４０に対してその両側（一方側が透明基板２０及び基板保護膜３０、他方側が薄膜保護膜５０）が温度変化により与える曲げモーメントが略打ち消し合うように、薄膜保護膜５０及び基板保護膜３０の設定を行えば、本実施の形態における湿度変化に起因する変形の防止のみならず、温度変化に起因する変形をも防止することができる。

【００５５】上記のように変形の中立面を薄膜層４０内に設ける場合には、一般に光ビームの入射側となる基板保護膜３０の膜厚は、薄膜保護膜５０の膜厚より薄い方

が良いため、それを満たすような線膨張係数等を有する保護膜材料を選択することが望ましい。

【００５６】なお、以上の実施の形態では変形の中立面が薄膜層内に位置するように媒体を構成したが、薄膜層近傍にあっても良い。勿論、薄膜層内にあることが変形量を減少させる上で望ましい。

【００５７】以上の実施の形態１、実施の形態２において説明した本発明の原理は、実施例１～３より薄いポリカーボネイト基板等を用いた場合においても成り立つ。その具体例について、以下に説明する。

【００５８】実施例4として、板厚０．５ｍｍの透明基板を用い、下記表５に示す構成の媒体を形成した。

【００５９】

【表５】

	材質	膜厚	ﾔﾝｸﾞ率(Pa)	線膨張係数 (1/℃)	透湿度 (g/m²・day)
基板保護膜	UV硬化樹脂6	3μm	6.8E+9	5.0E－5	2.2E＋2
透明基板	ﾎﾟﾘｶｰﾎﾞﾈｲﾄ	0.5mm	3.3E+9	6.0E－5	
薄膜層	窒化ｱﾙﾐﾆｳﾑ	79nm	3.4E+11	5.6E－6	
薄膜保護膜	UV硬化樹脂7	12μm	5.9E+9	7.2E－5	4.6E＋2

【００６０】この実施例4の媒体の温度変化時、及び湿度変化時における反り角θの変化量を測定した。図９、１０はその結果を示す図である。なお、透明基板の大きさは、内径φ７ｍｍ、外径φ５０ｍｍである。

【００６１】図9は、雰囲気を温度２５℃湿度５０％から温度７０℃湿度３０％に変化させたときの媒体の外周部における反り角θの変化量を示している。この結果では、基板厚がより薄い（実施例４では０．５ｍｍ）場合においても、温度変化時における反りの変化量は３ｍｒａｄ程度であった。従来の手法により表５の条件の薄い透明基板を用いた場合、反りの変化量が１０ｍｒａｄはるかに超えていたため、本発明により反りの変化を大幅に抑制できることがわかる。

【００６２】また、図１０は雰囲気を温度２５℃湿度６０％から温度２５℃湿度９０％に湿度を変化させたときの媒体の外周部における反り角θの変化量を示している。この結果より、基板厚がより薄い（実施例４では０．５ｍｍ）場合においても、湿度変化時における反りの変化量が非常に小さいことが分かった。

【００６３】

【発明の効果】本発明では、光情報記録媒体を温度変化による変形時の中立面が磁性膜等の薄膜層近傍（望ましくは薄膜層内）にあるように構成することにより、温度変化時における変形量を小さくして、記録再生の信頼性を高めることができる。

【００６４】また、上記光情報記録媒体において、透明基板よりもヤング率，線膨張係数の少なくとも一方が大きな薄膜保護膜を設けることにより、薄膜保護膜の膜厚を薄くできる。これにより製造が容易になると共に、光磁気記録媒体の場合、その磁気特性を向上することができる。

【００６５】また、光情報記録媒体において薄膜保護膜の透湿度より小さい透湿度を有する基板保護膜を設けることにより、湿度変化時における変形量が小さくなり、記録再生の信頼性を高めることができる。

【図面の簡単な説明】

【図１】光情報記録媒体の構成を示す断面模式図である。

【図２】光情報記録媒体の反りを説明する図である。

【図３】多層はりを説明する図である。

【図４】温度変化時における反り角の変化量の時間依存性を示す図である。

【図５】湿度変化時における反り角の変化量の時間依存性を示す図である。

【図６】光情報記録媒体の構成を示す平面図，側面図である。

【図７】従来の光情報記録媒体の一例を示す断面模式図である。

【図８】従来の光情報記録媒体の他の例を示す断面模式図である。

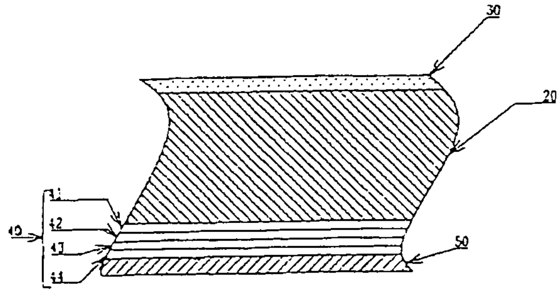
【図９】板厚０．５ｍｍの光記録媒体の温度・湿度を変化させたときの反り角の変化量の時間依存性を示す図である。

【図１０】板厚０．５ｍｍの光記録媒体の湿度変化時における反り角の変化量の時間依存性を示す図である。

【符号の説明】

１０　光情報記録媒体
２０　透明基板
３０　基板保護膜
４０　薄膜層
４１　第１誘電体膜
４２　記録膜
４３　第２誘電体膜
４４　反射膜
５０　薄膜保護膜

【図１】



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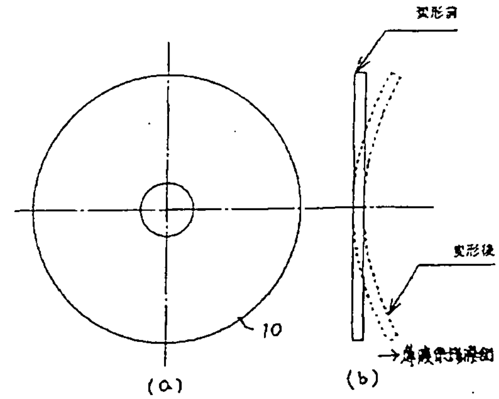

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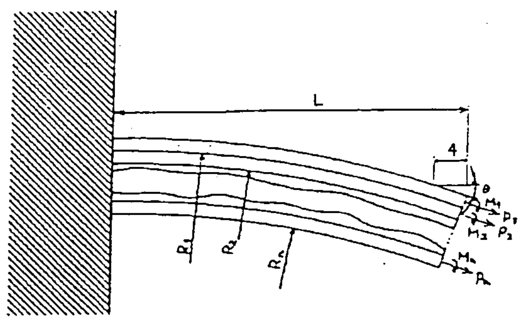

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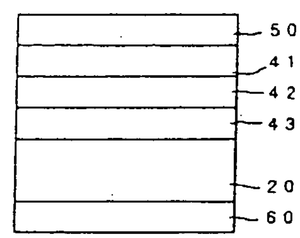

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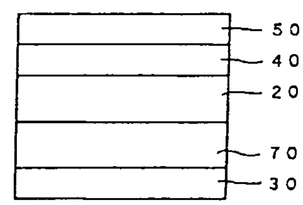

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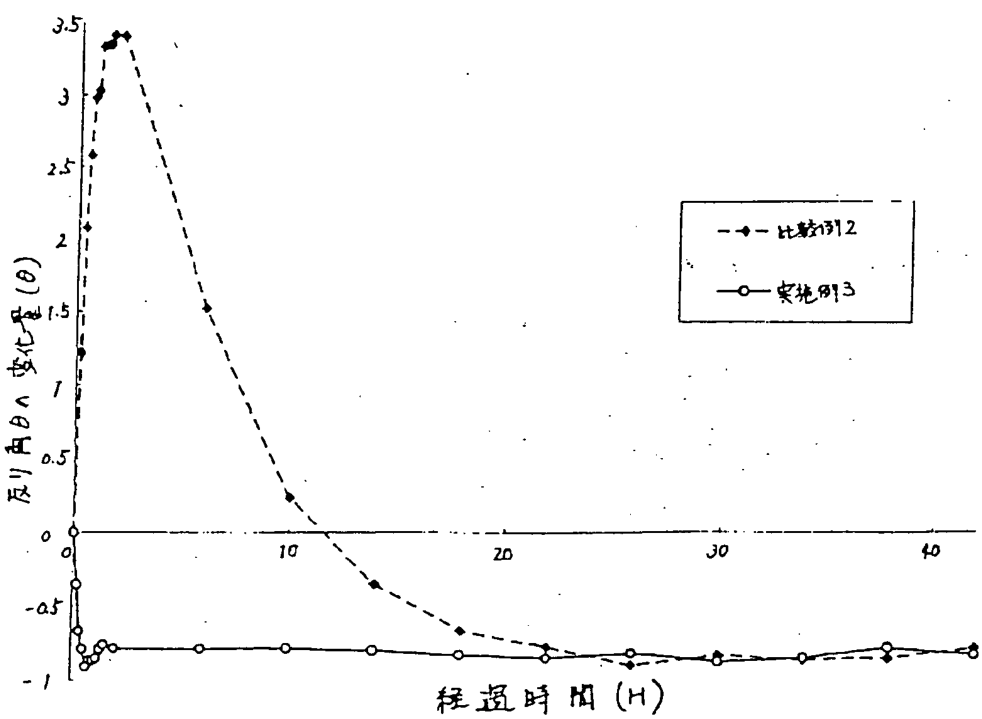

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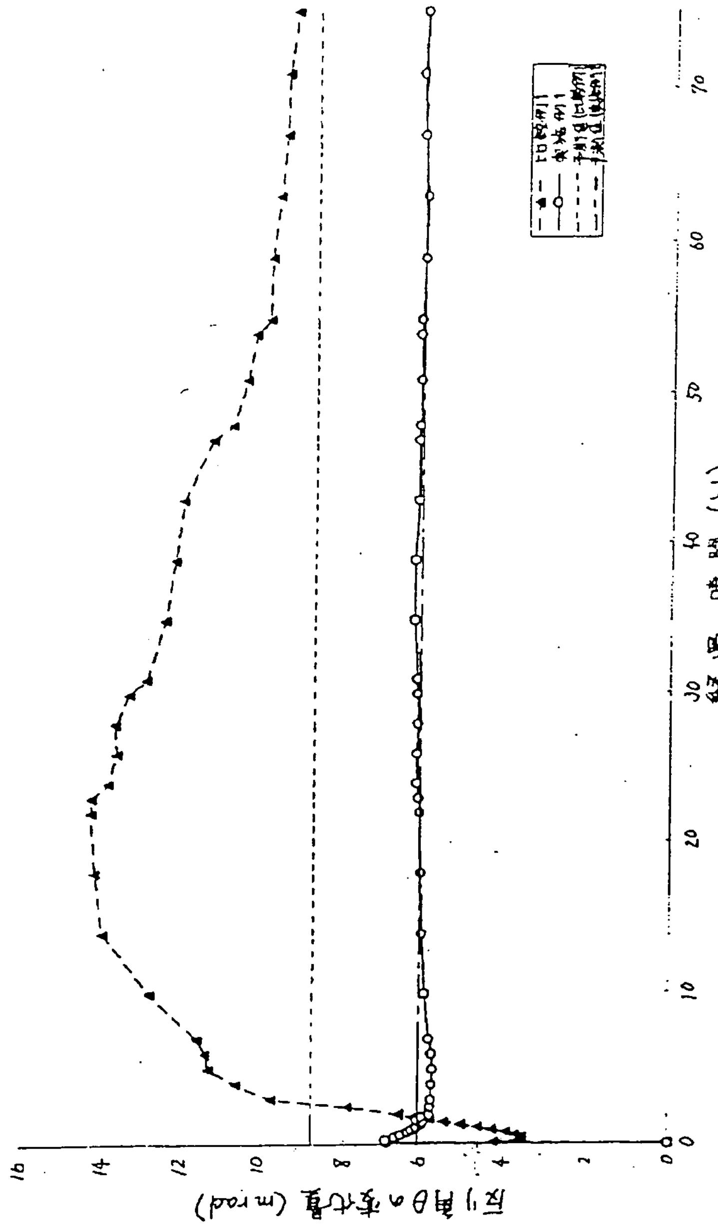

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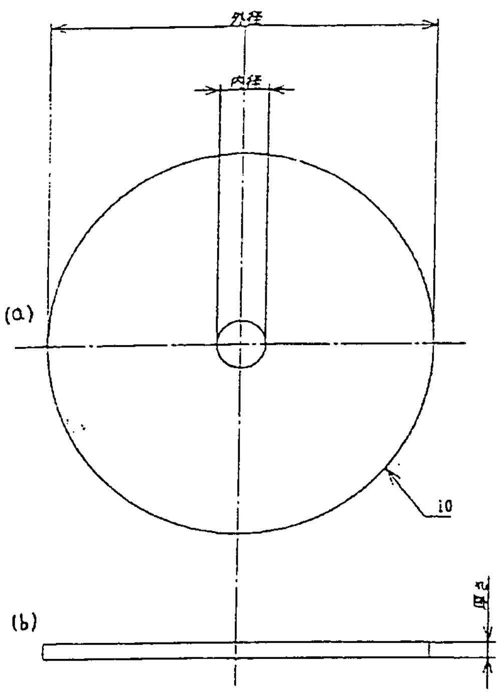
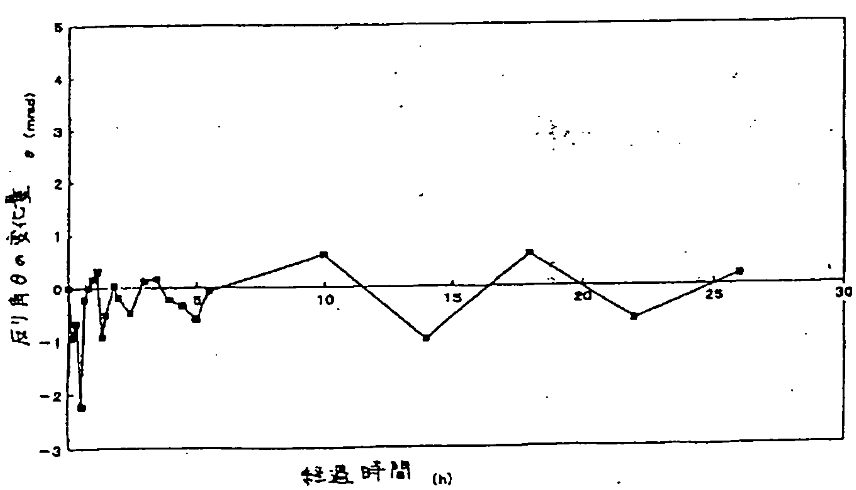
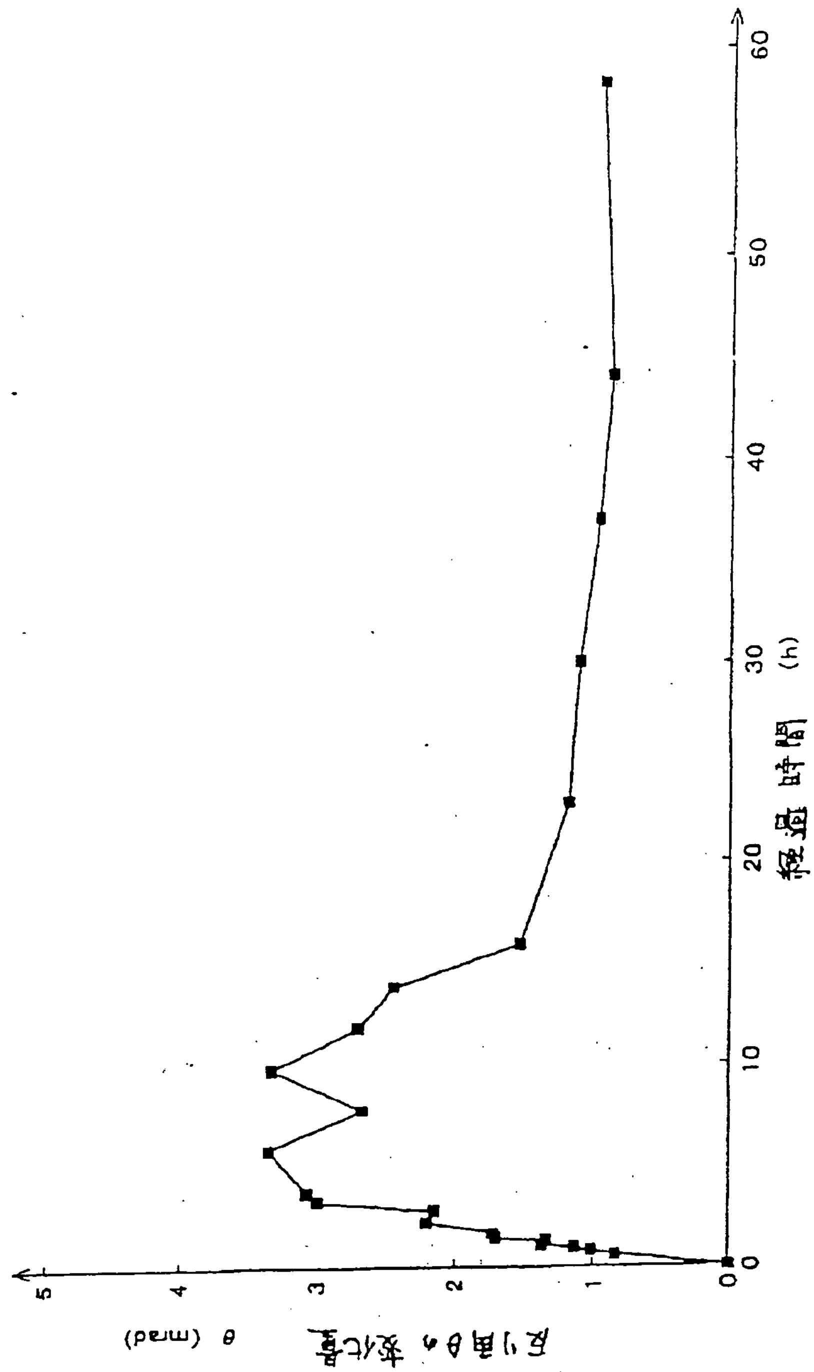


【図１０】



【図9】



DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] This invention relates to the optical information record medium which can suppress the curvature by the environmental variation or aging especially about the optical information record medium which records or reproduces information.
[0002]
[Description of the Prior Art] Drawing 1 is the cross section showing the composition of an optical information record medium. Drawing 6 is the plan (a) and side elevation (b) of the optical information record medium.
[0003] As this optical information record medium is shown in drawing 1 and 6, the monolayer which consists of thin films, such as dielectric films 41 and 43 (silicon nitride etc.), record film 42 (TbFeCo etc.), and the reflective films 44 (aluminum etc.), by the spatter etc., or the thin film layer 40 which consists of a multilayer is formed on the disc-like substrate 20 which consists of a polycarbonate etc. Moreover, the substrate protective coat 30 to which the thin film protective coat 50 by the resin film etc. consists of a resin etc. on the optical plane of incidence of a substrate is formed on this thin film layer 40. The thickness of 10-300 [nm], and the thin film protective coat 50 is [the thickness of 1-30 [mum] and the substrate protective coat 30] 1-30 [mum], and, as for the thickness of the monolayer in which, as for the thickness of each of these layer and a film, a substrate 20 is formed by about 1.2 [mm], the spatter, etc., or the multilayered-film layer 40, most overall thickness is occupied by the polycarbonate substrate 20. For this reason, the most depended for the rigidity of an optical information record medium on the polycarbonate substrate 20, and since the polycarbonate substrate 20 was thick enough, the deformation by the environmental variation (temperature-and-humidity change) was very small. For this reason, in almost all cases, the balance of the stress or the bending moment which are generated on each class was not usually taken into consideration.
[0004] However, in an optical information record medium, the further high-density record reproduction is called for, and in order to suppress generating of aberration, it is in the inclination (example 1.2[mm] ** ->0.6[mm] **) which a substrate thin-shape-izes. In this case, naturally the problem that fall, deformation resulting from the stress generated on each class which forms the optical information record medium by the environmental variation (temperature-and-humidity change) becomes large, and informational record reproduction becomes difficult produces the rigidity of an optical information record medium. Therefore, when a substrate becomes thin and rigidity falls, the optical information record medium with the high performance for environment is called for.
[0005] The technique of curving in JP,4-195745,A at the rear face (near field in which a thin film layer is not formed) of a substrate, and preparing the dielectric film for prevention as the technique of suppressing deformation of an optical information record medium, is proposed.
[0006] Drawing 7 is the cross section showing the composition of this optical information record medium. In addition, in drawing 7 , the same sign is attached about the same portion as drawing 1 . It enables it to prevent the curvature of an optical information record medium for an optical information record medium by this as symmetrical structure to the transparent substrate 20 here by forming a dielectric layer 60 in the optical incidence side of the polycarbonate substrate 20, and making equivalent the expansion coefficient of the record film 42 and the dielectric layer 60 which are located in the both sides of the transparent substrate 20, as shown in drawing 7 .
[0007] Moreover, lessening the curvature by the temperature rise of an optical disk is indicated by JP,10-64119,A by applying a thin film protective coat thickly.
[0008] Moreover, in the optical information record medium which has the thin film protective coat 50 as shown in drawing 8 , the thin film layer 40, a substrate 20, and the substrate protective coat 30, what formed the moisture permeation prevention film 70 which consists of SiO_2 or AlN between a substrate 20 and the substrate protective coat 30 is proposed by JP,4-364248,A by making for an optical information record medium to curve by humidity into a problem. In addition, in drawing 8 , the same sign is attached about the same portion as drawing 1 .
[0009]
[Problem(s) to be Solved by the Invention] however, by the technique (refer to drawing 7) of a publication, to JP,4-195745,A Since there is the need of preparing a dielectric layer in the optical incidence side of a substrate by the spatter etc., In production, after forming a thin film layer in the field of one side to a substrate, while it is necessary to form a dielectric layer in the field of **** repeat ******** and a process complicates the substrate, expensive rank-ization of a production facility is **(ed), and there is a problem of leading to a cost rise.

[0010] Moreover, by technique given in JP,10-64119,A, the thickness of a thin film protective coat becomes thick too much, and there is a problem that there is manufacture top difficulty. Moreover, for example, when an optical information record medium is a magneto-optic-recording medium, the thickness of a thin film protective coat is thick, it is desirable to approach to reverse the magnetic field impressed at the time of record at high speed in a magnetic field generating means and a thin film layer, and it is a bird clapper ** degradation of magnetic properties and] a problem.
[0011] Furthermore, since the need of preparing SiO2 and AlN by the spatter etc. is in the optical incidence side of a substrate also by technique (refer to drawing 8) given in JP,4-364248,A, In production, after forming a thin film layer in the field of one side to a substrate, while it is necessary to form a dielectric layer in the field of **** repeat ******** and a process complicates the substrate, expensive rank-ization of a production facility is **(ed), and there is a problem of leading to a cost rise.
[0012] this invention aims at being made in order to solve the above-mentioned technical problem, being able to prevent the deformation (curvature) accompanying temperature-and-humidity change, and offering an optical information record medium with the easy manufacture.
[0013]
[Means for Solving the Problem] An optical information record medium according to claim 1 is characterized by for the neutral plane of deformation of the direction of thickness by the temperature change at the time of record reproduction to be near [a thin film layer] the above in the optical information record medium which has at least a transparent substrate, the thin film layer which is formed on this transparent substrate and contains either record film or a reflective film at least, and the thin film protective coat which makes a principal component the resin formed on this thin film layer.
[0014] The bending moment which receives a transparent substrate, the thin film layer which is formed on this transparent substrate and contains either record film or a reflective film at least, and the thin film protective coat which makes a principal component the resin formed on this thin film layer from the both sides in the direction of thickness [near / aforementioned / the thin film layer] in the optical information record medium which it has at least is in abbreviation etc. by carrying out, and an optical information record medium according to claim 2 is characterized by things.
[0015] In the optical information record medium which has at least the thin film layer which an optical information record medium according to claim 3 is formed on a transparent substrate and this transparent substrate, and contains either record film or a reflective film at least, and the thin film protective coat which makes a principal component the resin formed on this thin film layer, the aforementioned thin film protective coat is characterized by either [at least] the Young's modulus or coefficient of linear expansion being larger than the aforementioned transparent substrate.
[0016] An optical information record medium according to claim 4 is characterized by the thickness of the aforementioned thin film protective coat being 20 micrometers or less in an optical information record medium according to claim 1 to 3.
[0017] The thin film layer which an optical information record medium according to claim 5 is formed on a transparent substrate and this transparent substrate, and contains either record film or a reflective film at least, In the optical information record medium which has at least the thin film protective coat which makes a principal component the resin formed on this thin film layer, and the substrate protective coat which makes a principal component the resin formed in the optical incidence side of the aforementioned transparent substrate, it is characterized by the moisture vapor transmission of the aforementioned substrate protective coat being smaller than the moisture vapor transmission of the aforementioned thin film protective coat.
[0018] The neutral plane of deformation of the direction of thickness according [an optical information record medium according to claim 6 / on an optical information record medium according to claim 5 and] to the temperature change at the time of record reproduction is near [a thin film layer] the above, and it is characterized by the thickness of the aforementioned thin film protective coat being thicker than the thickness of the aforementioned substrate protective coat.
[0019] In addition, in the claim 1, in formula (1) - (5) mentioned later, the neutral plane of deformation shows the field expressed with the value of y, when camber-angle theta becomes abbreviation 0.
[0020]
[Embodiments of the Invention] (Gestalt 1 of operation) Hereafter, although the optical information record medium of the gestalt of this operation is explained, the principle of this invention is explained first.
[0021] ** As the term of a principle Prior art explained, with the optical information record medium given in JP,4-195745,A (refer to drawing 7), the curvature of an optical information record medium was suppressed with constituting a layer so that it may become symmetrical to the transparent substrate 20.
[0022] On the other hand, this invention person sets to the optical information record medium which has the thin film protective coat 50 as shown in the cross section of drawing 1 , the thin film layer 40, the transparent substrate 20, and the substrate protective coat 30. (a) The point which can suppress curvature by setting the thin film layer 40 as the center of deformation by the temperature change, i.e., constituting symmetrically to a thin film layer, and the point which combines with suppression of (b) curvature and can make thin thickness of the thin film protective coat 50 were found out. Hereafter, it explains in more detail.
[0023] As shown in drawing 1 , generally an optical information record medium On the transparent substrates 20, such as a polycarbonate, by the spatter etc. Dielectric films 41 and 43 (silicon nitride etc.), While having the monolayer or the multilayer thin film layer 40 which consists of thin films, such as record film 42 (TbFeCo etc.) and the reflective films 44 (aluminum etc.), and forming the thin film protective coat 50 which makes a resin a principal component on the thin film layer 40 In order to protect the transparent substrate 20 on the opposite field of the transparent substrate 20, the substrate protective coat 30 which makes a resin a principal component is formed.
[0024] Thus, the optical information record medium usually consists of multilayers, for this reason, originates in a difference of the coefficient of linear expansion which is the physical-properties value of each class etc., and brings a result from which the

stress generated on each class at the time of a temperature change differs. Specifically, generally, the coefficient of linear expansion of the transparent substrate 20 which consists of a polycarbonate and the substrate protective coat 30, and the thin film protective coat 50 is large as compared with it of the thin film layer 40, and the expansion to radial [of the substrate of the thin film layer 40] becomes very small as compared with other each class. Moreover, the thickness of the transparent substrate 20 is very large as compared with the thickness of the substrate protective coat 30 and the thin film protective coat 50, and the Young's modulus of each thin film of the thin film layer 40 becomes very large as compared with other layers. For this reason, if a temperature change arises, as a result, the optical information record medium 10 will be perpendicular to radial, and the curvature with small expansion of the thin film layer 40 which goes to the thin film protective coat 50 side in the direction of thickness will become easy for it to compare a thing and for expansion of the transparent substrate 20 to become large, and to produce it. Drawing 2 is a ** type view explaining the curvature, (a) is a plan and (b) is a side elevation.

[0025] In order to prevent this curvature with the form of this operation, by adjusting the coefficient of linear expansion of the thin film protective coat 50 formed on the thin film layer 40, Young's modulus, and thickness, to the thin film layer 40, it is contained in bending moment **** of the bending moment by the transparent substrate 20, and a retrose, and the thin film layer 40, and the deformation (curvature as shown in drawing 2) by the temperature change is suppressed by making a field parallel to a film surface into the neutral plane of deformation.

[0026] The following approximation calculations can perform a setup of the coefficient of linear expansion of the above thin film protective coats 50, Young's modulus, and thickness.

[0027] Although the stress (axial tension) committed to radial at the time of a temperature change, the stress committed to a circumferencial direction, and the stress committed in the direction of thickness occur in the optical information record medium 10 In order that the optical information record medium 10 may work uniformly [since it is disc-like / the stress committed to a circumferencial direction becomes uniform within a periphery, and / the force of the direction of thickness] within each class, Since it can assume that it does not contribute to deformation, deformation (refer to drawing 2) of the optical information record medium 10, i.e., curvature , can be replaced by the curvature in the multilayer beam equivalent to the cross-section section. Drawing 3 is drawing showing the multilayer beam. In addition, although drawing 3 shows the n layer beam, this n is the number of layers of an optical information record medium, and, in the case of the optical information record medium of drawing 1 , is n= 7.

[0028] Formula (1) - (5) drawn from the axial tension Pi (i= 1, 2, --, n) of each class and balance of the bending moment Mi can express the degree theta of camber angle at the time of the temperature change in this multilayer beam.

[0029]

[Equation 1]

$$M_i = \frac{E_i I_i}{R_i} \quad .\ .\ .\ .\quad (1)$$

$$\alpha_i T + \frac{P_i}{bt_i E_i} - \frac{t_i}{2R_i} = \alpha_{i+1} T + \frac{P_{i+1}}{bt_{i+1} E_{i+1}} + \frac{t_{i+1}}{2R_{i+1}} \quad .\ .\ .\ .\quad (2)$$

$$\sum_{i=1}^{n} P_i = 0 \quad .\ .\ .\ .\quad (3)$$

$$\sum_{i=1}^{n} M_i + P_1\left(y - \frac{t_1}{2}\right) + P_2\left(y - t_1 - \frac{t_2}{2}\right) + \cdots + P_n\left(y - t_1 - t_2 - \cdots - \frac{t_n}{2}\right) = 0 \quad .\ .\ .\ .\quad (4)$$

$$\theta = \tan^{-1}\left(\frac{L-2}{R}\right) \quad .\ .\ .\ .\quad (5)$$

[0030] In addition, each sign in formula (1) - (5) is the coefficient of linear expansion of alphai:i layer. Young's modulus ti:i layer thickness of an Ei:i layer The bending moment in the axial-tension Mi:i layer in an Pi:i layer Ri: The secondary cross-section moment of a radius-of-curvature Ii:i layer b: Width of face of a beam (it considers as a unit length)
T: Change temperature L: The degree of camber angle with a length [in the neutral plane position theta:maximum displacement section of the length y:n layer beam of a beam] of 4mm is shown. Moreover, since it is far small as compared with radius of curvature, the radius of curvature in each class (i= 1, 2, --, n) makes thickness of each class the same (R1=R2=R3=--=R). Moreover, the change temperature T is the change temperature within the service-temperature environment (generally -15 degrees C - 80 degrees C) of an optical information record medium.

[0031] And so that theta may become small, when y is set up in the thin film layer 40 in this formula (1) - (5) that is, if the thickness of each class (especially thin film protective coat 50 (being beforehand decided with the property of an optical information record medium about the thin film layer 40 -- ** -- many)), coefficient of linear expansion alpha, and Young's modulus E are determined that radius of curvature R will become large The optical information record medium which can suppress the curvature of drawing 2 accompanying a temperature change can be obtained.

[0032] By the way, if the thickness of the thin film protective coat 50 becomes thick in an optical information record medium, it will become difficult to form it on a spin coat. Moreover, if the thickness of the thin film protective coat 50 becomes thick when an optical information record medium is a magneto-optic-recording medium, the distance of the magnetic head and the thin film layer 40 will separate, and it is not desirable on magnetic properties. As for the thickness of these things to the thin film

protective coat 50, it is still better desirable to set it as 20 micrometers or less 30 micrometers or less. Therefore, as a thin film protective coat 50, while fulfilling the above-mentioned thickness conditions (30 micrometers or less (desirably 20 micrometers or less)), it is required to select the material of the coefficient of linear expansion alpha which can make theta small in above-mentioned formula (1) - (5), and Young's modulus E. Formula (1) If at least one side of coefficient of linear expansion alpha and Young's modulus E is large according to - (5), even if thickness is small, it is possible to make theta small.
[0033] Since each class (especially thin film protective coat 50) is set up so that the neutral plane of the deformation at the time of a temperature change may come by the optical information record medium of the form of this operation in the thin film layer 40 as explained above, generating of curvature can be suppressed. Moreover, the over shoot of the variation rate which deformation of the latest thin film layer 40 of deformation velocity becomes very small in each class which constitutes the optical information record medium, and poses a problem at the time of an actual temperature change also becomes a small thing. Furthermore, since what is necessary is to form in the optical incidence side of the transparent substrate 20 only the substrate protective coat 30 which makes a resin a principal component, it can manufacture easily with a spin coat etc. and a manufacturing process can be simplified.
[0034] In addition, although the above-mentioned explanation described setting up each class (especially thin film protective coat 50) using the material property of all the layers that constitute an optical information record medium so that the neutral plane of deformation by the temperature change might exist in the interior of the thin film layer 40 Since each class which constitutes the thin film layer 40 in an optical information record medium is generally very thin, It may consider that the thin film layer 40 is one layer, and you may set up each class (especially thin film protective coat 50) so that the bending moment which the both sides (one side is the transparent substrate 20 and the substrate protective coat 30, and the other side is the thin film protective coat 50) give by the temperature change to the thin film layer 40 may carry out an abbreviation denial mutually. Even in this case, ****** can make abbreviation of the curvature by the temperature change of the thin film layer 40 there be nothing. If an example is taken [that the thickness of the transparent substrate 20 is large for making small thickness of the thin film protective coat 50 (30 micrometers or less (desirably 20 micrometers or less)) at this time, and], at least one side of the coefficient of linear expansion alpha of the thin film protective coat 50 and Young's modulus E needs to be larger than the transparent substrate 20.
[0035] ** Explain an example, next the example of the optical information record medium formed based on the above-mentioned principle. In addition, this example assumes that the thin film layer 40 consists only of one layer of alumimium nitride. This is because, as for deformation of the thin film layer 40, dielectric layers, such as alumimium nitride, generally mainly become the cause in many cases. Moreover, this example shows the example without the substrate protective coat 30. When the substrate protective coat 30 exists, it is necessary to set up each class (especially thin film protective coat 50) also in consideration of it.
[0036] As an example 1, the medium by which an alumimium nitride thin film layer (thin film layer 40) and the formula (1) ultraviolet-rays (UV) hardening resin 1 (thin film protective coat 50) of the conditions designed using - (5) were formed on the polycarbonate substrate (transparent substrate 20) was formed. Moreover, the optical information record medium with which an alumimium nitride thin film layer and conventional ultraviolet-rays (UV) hardening resin 2 (thin film protective coat) were formed on the polycarbonate substrate as an example 1 of comparison was formed. The composition of an example 1 and the example 1 of comparison is shown in Tables 1 and 2, respectively.
[0037]
[Table 1]

実　施　例　1

	材質	膜厚	ヤング率(Pa)	線膨張係数(1/°C)
透明基板	ポリカーボネイト	0.6mm	2.41E+09	6.00E-05
薄膜層	窒化アルミニウム	79nm	3.43E+11	5.60E-06
薄膜保護層	UV硬化樹脂1	16μm	1.80E+09	7.10E-05

[0038]
[Table 2]

比　較　例　1

	材質	膜厚	ヤング率(Pa)	線膨張係数(1/°C)
透明基板	ポリカーボネイト	0.6mm	2.41E+09	6.00E-05
薄膜層	窒化アルミニウム	79nm	3.43E+11	5.60E-06
薄膜保護層	UV硬化樹脂2	15μm	1.80E+09	5.62E-05

[0039] As shown in Tables 1 and 2, the difference among both is mainly the coefficient of linear expansion of UV hardening resin (thin film protective coat 50), and the direction of an example 1 is using [coefficient of linear expansion] the large thing. In addition, as a transparent substrate 20, both are using bore phi15mm and the thing with an outer diameter of 120mm.
[0040] The temperature change (the above-mentioned T= 30 degrees C) which rises at 25 degrees C -> 55 degrees C to the medium of an example 1 and the example 1 of comparison was given, and aging of the variation of camber-angle theta in the periphery section (r= 56mm) at that time was measured. In addition, in an ordinary temperature state, since the medium has an original camber angle, the reason for having measured the variation of not the camber angle itself but a camber angle is because

it is disqualified for deformation by the temperature change being shown.
[0041] Drawing 4 is drawing showing the result. The variation of the camber angle of the medium of an example 1 of both maximum and a steady state value is smaller than the medium of the example 1 of comparison, and it turns out that deformation is suppressed. Moreover, it turns out that according to the example 1 big curvature does not arise [temperature] from this drawing temporarily by change even if it is thickness 20 micrometers or less. Furthermore, although the variation of camber-angle theta expected using above-mentioned formula (1) - (5) is written together to drawing 4 , as for near and its approximation, it turns out that approximation by above-mentioned formula (1) - (5) actually conforms to an actual measurement very much.
[0042] Next, the medium (example 2) which used UV hardening resin 3 with big Young's modulus is explained. The media of this example 2 differ in the medium of an example 1, and the property of UV hardening resin. The composition of an example 2 is shown in Table 3.
[0043]
[Table 3]

実　施　例　2

	材質	膜厚	ヤング率(Pa)	線膨張係数(1/℃)
透明基板	ポリカーボネイト	0.6mm	2.41E+09	6.00E-05
薄膜層	窒化アルミニウム	79nm	3.43E+11	5.60E-06
薄膜保護層	UV硬化樹脂3	16μm	3.60E+09	5.68E-05

[0044] When the variation of camber-angle theta is expected about the medium of this example 2 using above-mentioned formula (1) - (5), the value is 5.18 [mrad] and it turns out that the curvature which originates in a temperature change sharply as compared with the above-mentioned example 1 of comparison is decreasing.
[0045] As mentioned above, since it can suppress that big curvature arises also temporarily by the temperature change according to the optical information record medium of the gestalt of this operation, it can suppress that problems, such as poor reproduction, also produce **** in the temperature rise at the time of record reproduction. Moreover, thickness of the thin film protective coat 50 can be made thin.
[0046] (Gestalt 2 of operation) The gestalt of this operation explains the optical information record medium which can prevent deformation by humidity.
[0047] ** Since the substrate which consists of a polycarbonate etc. as a transparent substrate 20 is used for the optical information record medium 10 given in drawing 1 which carried out principle ****, when the circumference becomes highly humid, the transparent substrate 20 expands according to moisture absorption. And thereby, deformation arises in the optical information record medium 10. Since the moisture vapor transmission of the substrate protective coat 30 became [the deformation velocity of a substrate 20] larger than the deformation velocity of the thin film protective coat 50 especially when large as compared with the moisture vapor transmission of the thin film protective coat 50, the over shoot of a big variation rate occurred at the time of actual humidity, and it had become a big problem on practical use.
[0048] With the gestalt of this operation, the problem at the time of practical use is solved by making small the moisture vapor transmission of the substrate protective coat 30 as compared with the moisture vapor transmission of the thin film protective coat 50, and suppressing this over shoot.
[0049] ** The medium which added the substrate protective coat 30 which consists of UV hardening resin 4 to the medium given in the above-mentioned example 1 as an example example 3 was formed. Moreover, the medium which added the substrate protective coat 30 which consists of UV hardening resin 5 to the medium given in the above-mentioned example 1 as an example 2 of comparison was formed for comparison. The moisture vapor transmission of each UV hardening resin in this example 3 and the example 2 of comparison is shown in Table 4.
[0050]
[Table 4]

	基板保護膜		薄膜保護膜	
	膜種	透湿度(g/m^2·day)	膜種	透湿度(g/m^2·day)
実施例3	UV硬化樹脂4	2.20E+02	UV硬化樹脂1	4.60E+02
比較例2	UV硬化樹脂5	9.70E+02	UV硬化樹脂1	4.60E+02

[0051] To the medium of this example 3 and the example 2 of comparison, humidity (ambient humidity is changed to 50% -> 90%) was given, and aging of the variation of camber-angle theta in the periphery section (r= 56mm) of each medium was measured.
[0052] Drawing 5 is drawing showing the result. It turns out that the maximum (it generates at the time of overshoot) of the variation of the camber angle of an example 3 becomes a very small thing as compared with it of the example 2 of comparison, and deformation by humidity is suppressed.
[0053] Thus, according to the optical information record medium of the form of this operation, even if humidity changes, it can suppress that big curvature does not arise temporarily and problems, such as poor reproduction, arise at the time of record reproduction.

[0054] In addition, also in the optical information record medium of the form of this operation, so that it may have the neutral plane of deformation by the temperature change in the thin film layer 40 like a publication in the form 1 of operation Moreover, so that the bending moment which the both sides (one side is the transparent substrate 20 and the substrate protective coat 30, and the other side is the thin film protective coat 50) give by the temperature change to the thin film layer 40 may carry out an abbreviation denial mutually If a setup of the thin film protective coat 50 and the substrate protective coat 30 is performed, not only prevention of deformation resulting from the humidity in the form of this operation but the deformation resulting from a temperature change can be prevented.
[0055] When preparing the neutral plane of deformation in the thin film layer 40 as mentioned above, since the one thinner than the thickness of the thin film protective coat 50 is good, as for the thickness of the substrate protective coat 30 which generally becomes the incidence side of a light beam, it is desirable to choose the protective coat material which has coefficient of linear expansion which fills it.
[0056] In addition, although the medium was constituted from a form of the above operation so that the neutral plane of deformation might be located in a thin film layer, you may be near the thin film layer. Of course, it is desirable when that it is in a thin film layer decreases deformation.
[0057] The principle of this invention explained in the form 1 of the above operation and the form 2 of operation is realized when a polycarbonate substrate thinner than examples 1-3 etc. is used. The example is explained below.
[0058] The medium of composition of being shown in the following table 5 was formed using the transparent substrate of 0.5mm of board thickness as an example 4.
[0059]
[Table 5]

	材質	膜厚	ﾔﾝｸﾞ率(Pa)	線膨張係数 (1/℃)	透湿度 (g/m²·day)
基板保護膜	UV硬化樹脂6	3μm	6.8E+9	5.0E−5	2.2E+2
透明基板	ﾎﾟﾘｶｰﾎﾞﾈｲﾄ	0.5mm	3.3E+9	6.0E−5	
薄膜層	窒化ｱﾙﾐﾆｳﾑ	79nm	3.4E+11	5.6E−6	
薄膜保護膜	UV硬化樹脂7	12μm	5.9E+9	7.2E−5	4.6E+2

[0060] The variation of camber-angle theta at the time of the temperature change of the medium of this example 4 and humidity was measured. Drawing 9 and 10 are drawings showing the result. In addition, the sizes of a transparent substrate are bore phi7mm and outer-diameter phi50mm.
[0061] Drawing 9 shows the variation of camber-angle theta in the periphery section of the medium when changing atmosphere from 50% of temperature humidity of 25 degrees C to 30% of temperature humidity of 70 degrees C. Also setting in this result, when basis board thickness was thinner (an example 4 0.5mm), the variation of the curvature at the time of a temperature change was about 3 mrads. Since the variation of curvature had exceeded far 10 mrads when the thin transparent substrate of the conditions of Table 5 was used by the conventional technique, it turns out that change of curvature can be sharply suppressed by this invention.
[0062] Moreover, drawing 10 shows the variation of camber-angle theta in the periphery section of the medium when atmosphere changing humidity from 60% of temperature humidity of 25 degrees C to 90% of temperature humidity of 25 degrees C. It also set, when basis board thickness was thinner than this result (an example 4 0.5mm), and it turns out that the variation of the curvature at the time of humidity is very small.
[0063]
[Effect of the Invention] By constituting from this invention, as the neutral plane at the time of deformation according an optical information record medium to a temperature change is near [, such as a magnetic film,] the thin film layer (desirably inside of a thin film layer), deformation at the time of a temperature change can be made small, and the reliability of record reproduction can be raised.
[0064] Moreover, in the above-mentioned optical information record medium, thickness of a thin film protective coat can be made thin by preparing a thin film protective coat at least with bigger one side of Young's modulus and coefficient of linear expansion than a transparent substrate. While manufacture becomes easy by this, in the case of a magneto-optic-recording medium, the magnetic properties can be improved.
[0065] Moreover, by preparing the substrate protective coat which has a moisture vapor transmission smaller than the moisture vapor transmission of a thin film protective coat in an optical information record medium, the deformation at the time of humidity becomes small, and can raise the reliability of record reproduction.

[Translation done.]

Moreover, Applicants have measured the expansion coefficient under humidity of a medium having the composition shown in Example 3 of Tachibana (see Example 3, Column 8, lines 47-61).

<u>Example 3 of Tachibana</u>

KAYARAD DPCA-30: 70 wt. % (described in Tachibana as a caprolactone-modified dipentaerythritol hexaacrylate)

AKAYARAD R-604: 25 wt.% (described in Tachibana as a dioxane glycol acrylate)

IRG-185: 5 wt.% (described in Tachibana as a photopolymerization initiator)

As a result of the measurement, it is found that the medium has an expansion coefficient under humidity of 5.79×10^{-5} (1/%), which is outside the claimed value of less than 5.5×10^{-5} (1/%) recited in independent claims 1, 10 and 14 (and the claims dependent thereon). This experiment provides additional support for Applicants' contention that the cited references do not necessarily disclose materials for optical data recording media having the properties of the claimed media.

For at least the reasons discussed herein, Applicants urge that claims 1, 5, 6, 10-11 and 13-14 are patentable over the Tachibana patent. In addition, Applicants contend that claim 12, which recites balancing the bending moments of the transparent substrate and the protective film and describes the positional relationship between the neutral plane and the thin film layer, is also patentable over the Tachibana reference.

In summary, none of the cited documents, taken alone or in any combination, teach or suggest optical recording media which are resistant to deformation or warpage induced by changes in relative humidity. Moreover, none of the cited documents teach or suggest that the materials used in the fabrication of the optical recording media should be selected to have low expansion coefficients under humidity